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FOUNDRY TRADE JOURNAL
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Vol. 70 Thursday, May 20, 1943 No. 1396

Solid Fuel

The average foundryman now regards sand as grains of silver bonded by nature with clay or through human endeavour with an infinite variety of agglutinants. As for solid fuel, there is a general realisation that it is constituted of fixed carbon, volatile matter and ash. Both conceptions have helped him well enough along the road to the technical control of the processes he directs. There may be a sufficiency in the concept established for sand, but for solid fuels, the new ideas of the chemists are rapidly winning the interested support of the big wigs of industry and politics, which may cause foundrymen to revolutionise their standard practices. The fuel technologists, backed by their £1,000,000 five-year research plan, are postulating the notion that it is bordering on the criminal to burn raw coal, because thereby the community loses so many valuable by-products and gains so much deleterious smoke and fog. We well remember that in 1926, during an after-dinner talk with the late Lord Melchett, we discussed his vision of the future, which envisaged the conversion at the mines of all solid fuel into either gas or oil and piping these to the large cities. He recounted some of the many valuable derivatives obtainable, including a dye for communicating a sheen for the homely kippered herring. We believe that a rather crude advertisement issued by a Midlands metallurgical company, depicting a tree, with its trunk labelled coal and the branches the dozens of derivatives, has had a profound influence on the lay mind. There is too little recognition of the fact that, if most coal —we presume all coal is not inherently suitable— were so treated, the market for the by-products would be overstocked and the miners out of work. Thus we visualise only a fraction of the coal mined would be broken down so as to yield up its last ounce of chemical wealth. Mr. Rennie, in his recent speech as President of the Solid-fuel Firing Appliance Association, hinted that a well-designed fireplace burning coal was probably of higher thermal efficiency than an electric radiator. By the time coal has converted water to steam, the steam utilised for the generation of electricity and the electric power has been stepped down and distributed to the consumer, the efficiency as related to coal is only of the order of 15 per cent. This takes us back to the chemist's dream of replacing solid fuel supplies with oil or gas, and relating this to melting practice; we do not doubt the technicians could devise furnaces which would work with an efficiency comparable to existing plant, but the overall efficiency as related to the raw coal would be of much the same order as the electric radiator, and thereby the community as a whole would not benefit. Thus we hope that those charged with the spending of the million pounds on coal research will devote at least some of their time and money on seeking to retain or to enhance the quality of furnace coke, so that a standardised raw material of the highest quality will be made available for industry.

During the past few years the American grey-iron foundry industry has made notable advances in the production of high-tensile irons and special mixtures for castings tested under high pressure. To-day, with decidedly inferior quality in some raw materials and with the necessity for entirely eliminating the use of some alloys and of finding substitute methods, it is satisfactory to note that the quality of the product is being maintained and that the rigid specifications demanded in war production work are being met, considers H. S. WASHBURN, president, the Plainville Casting Company, Plainville, Conn., in a review of progress in "Steel."

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HOLDING DOWN CORES

By "CHECKER"

There are occasions when internal cores have to be held down in the mould with sprigs, to prevent them moving out of position, in which case the holes for the sprigs should be made through the cores before they go into the core stove; and as this cannot always be done efficiently after the core has been withdrawn from the corebox, it is necessary to make the holes in the core first. Fig. 1 shows a core which is fixed into position with sprigs, the two holes required for this purpose being shown dotted, and while the hole in the large end of the core could vary for position, the one in the small end must be made with a certain degree of accuracy owing to the small protruding parts of the core on both sides. Should this hole be misplaced to such an extent that it came out near the edge, there is always the danger that the core will break away when the sprig is pushed into position.

To ensure the holes being situated correctly in the core, the position of the holes required should be carried through the bottoms of the coreboxes, as

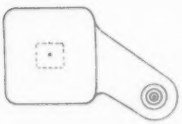


FIG. 1.

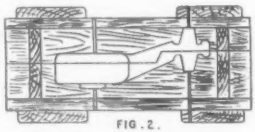


FIG. 2.

FIG. 3.

shown in Fig. 2; the holes being drilled in one half first, the two halves are then put together, with the half carrying the holes at the top. This acts as a jig, when the drill goes through the holes in the top to bore the holes in the bottom half in line with those above. This particular core has to be made in halves first, and when both halves have been made and the two parts of the corebox put together, it will be found that a straight wire can be put through the core from the top of the corebox, with the hole in the wood acting as a guide to give it the true direction, and the hole in the bottom half should be found without difficulty; using this method the holes in the cores will always be in the same relative position.

In the course of time it will be found that the wire pushed through the core will disfigure the wood around the hole in the bottom of the corebox; this can be avoided by cutting out a recess and placing a piece of metal in the proximity of the hole. When a core made from an open top corebox requires a hole through for sprigging, the hole should be drilled

(*Continued in next column.*)

THE CASTING OF BRASS INGOTS

Published in 1934 by the British Non-Ferrous Metals Research Association, "The Casting of Brass Ingots," by R. Genders and G. L. Bailey, enjoyed a wide circulation. It is now in considerable demand, and, as the original is out of print, the Association is re-issuing it by the photo-litho-offset process, complete with all illustrations as in the original edition. The book was based on a comprehensive series of investigations carried out by the authors for the Association, and as the fundamental principles emerging from these investigations remain unchallenged, no revision has been undertaken: it is felt that in its original form the book will be a valuable aid to industry, particularly to individuals and companies, unaccustomed to the technique of brass casting, who have turned under war conditions to this branch of metallurgical practice. The new issue (199 pp., 123 figures) will appear shortly, price 21s. Orders may be placed with the B.N.F.M.R.A., Euston Street, London, N.W.1, or with any bookseller.

U.S. FINISHED STEEL OUTPUT IN 1942

War demands for steel in the United States during 1942 were largely concentrated upon six major finished products, according to the American Iron and Steel Institute. These products were steel plates, structural shapes, hot-rolled carbon steel bars, alloy steel bars, tool steel bars, and barbed wire. Output of steel plates for sale was 11,543,000 tons, or 90 per cent. above the previous record in 1941. Structural shapes totalled 4,938,000 tons, or 8 per cent. over 1941; hot-rolled carbon steel bars, 6,589,000 tons, 2 per cent. over 1941; alloy steel bar, 2,512,000 tons, almost 20 per cent. above the best previous record. Production for sale in 1942 of tool steel bars and barbed wire, respectively 210,000 tons and 301,000 tons, was also above the 1941 levels. Other production totals for 1942 were:—Standard rails, 1,941,000 tons; drawn wire, 1,981,000 tons; and pipe and tubular products, 5,080,000 tons.

United States copper supply, which reached an all-time record of about 2,460,000 tons in 1941, was increased to nearly 3,000,000 tons in 1942, states the W.P.B. Division of Information. Scrap collection was a most important source of metal, resulting in more than 600,000 tons of refined copper during 1942. The most important problem in copper production during 1942 was shortage of labour.

(*Continued from previous column.*)

through the bottom of the box, as shown in the section Fig. 3, so that when the core has been made and the corebox turned over on to the plate before withdrawing, the hole can be made in the core by pushing a straight wire through both the hole in the bottom of the corebox and the core until it reaches the plate.

FLUID PRESSURE IN FOUNDRY PRACTICE*

Theory and laws of fluid pressure; its calculation in moulds and an analysis of comparative examples

By E. LONGDEN, M.I.Mech.E.

Fluid pressure plays a very important part in the production of castings. It is, therefore, a subject which should receive more attention by both the practical and technical foundrymen. These notes are compiled with a view to focussing attention on to the subject, and provoking, it is hoped, a useful discussion. First, a detailed examination of the excellent data published by Howard F. Taylor and Edward A. Rominski of work carried out in a Naval Research Department in the U.S.A. is recommended. The subject is "Utilising Atmospheric Pressure in Making Steel Castings,"† and it has been dealt with in a most scientific manner. Further brief references will be made to the work during the course of these notes.

What is meant by science? It is defined as knowledge reduced to system, and research as diligent search and search again and again. There are so many men who think lightly of any person referred to as a scientist or research worker; this is because they rarely look beyond the reasons for measurement and control. Have not most technical workers met this type of individual? Everybody is familiar with the kind of fellow who, when presented with a theory, an expected improvement in some process or device, or other thing, will say how wrong it is. He will recall how it was tried and proved wrong, probably fifty years ago. He will not even help by his sympathetic understanding, let along help materially to overcome what he considers an insurmountable difficulty. Therefore, to overcome difficulties the scientist trains himself not to be afraid of taking the next and succeeding steps in spite of Mr. Can't-be-done or Mr. Leave-it-alone.

Most people make only one attempt or step forward, and quickly become bored or tired. It is the last logical attempt which matters. Problems are difficult because of ignorance of the necessary factors governing the case. It is said that successful invention is 5 per cent. inspiration and 95 per cent. perseverance and hard work. However, foundrymen will continue to progress individually and collectively if they possess a healthy dissatisfaction with things they see around them, sufficiently to keep them awake. In the foundry there are many things around them which keep them from going to sleep, not the least being the incidence of fluid pressure.

The best known methods of exerting more than normal pressure on solidifying metals are by the various centrifugal and pressure die-casting processes. In these processes, pressures up to 100 atmospheres result from the forces employed. No emphasis is needed to extol the high qualities of castings made by either of the processes named.

In the year 1865 Sir Joseph Whitworth introduced a method of casting steel ingots under pressure. A similar process is stated to have been used by Bessemer as far back as 1856. The process consisted of pouring metal into a mould consisting of a strong steel jacket with a more or less porous lining. Steel was run into the jacketed mould, and great pressure put on it by means of a hydraulic ram, the pressure reaching up to 20 tons per sq. in. of horizontal section. As the pressure is exerted, there is a vigorous escape of gas and flame. The pressure results in a considerable reduction in the size of the ingot.

In the Whitworth process, pressure is applied at the top, but in a later application of high pressure by the use of mechanical devices introduced by Robinson and Rodger, of Sheffield, and Illingworth, of New York, U.S.A., the pressure was applied laterally. The moulds were made in halves. Initially, the half-moulds are held apart by packing, the packing being removed after a certain depth of solid metal had formed on the outside of the ingot in contact with the mould. The lateral pressure was then applied by hydraulic power.

Other means of exerting pressure are by employing carbon dioxide, air and steam. All these methods date from 50 years back, although there have been various modifications since to make the processes more commercially practicable, and scientific minds have recently addressed themselves to the problems. When the war is over the public will learn more of the spurt given to production methods by the application of science and technology generally. This is on the credit side of war and, God willing, the world would be better without war to secure such comparatively small benefits.

Aspects Needing Examination

Any consideration given to the influence of fluid pressure on the mould and casting must necessarily take account of and associate, at least, the following aspects:—

(1) What is the definition of fluid pressure? (2) What are the effects of fluid pressure on the different classes of moulds? (3) What are the effects of fluid pressure on the quality of the metal and the casting? (4) What methods are adopted in the construction of moulds to reduce the inherent weakness present in moulds, especially when made in sand? (5) What methods are adopted to secure cores in moulds to prevent their flotation or movement?

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. E. L. Howard presiding.

† See FOUNDRY TRADE JOURNAL for October 15, 22 and 29, 1942.

Fluid Pressure

But the various influences are so wide in extent that it is impossible to deal adequately with all aspects. Therefore, only brief references can be made to methods of control practised in the construction of moulds and cores to resist fluid pressure, especially methods to secure cores. Hydromechanics covers the properties of fluids, and it is divided into two divisions; the first division deals with fluids in equilibrium or at rest, and the second with fluids in motion.

THEORY AND LAWS OF FLUID PRESSURE

A fluid is defined as a body which exercises no permanent resistance to change of shape. It will, therefore, ultimately take up the shape of any vessel in which it is placed. Fluids are divided into two classes—liquids and gases—a further conditioning factor being the degree of viscosity.

(*a*) A liquid is a fluid, the volume of which does not increase indefinitely as the force upon its surface is reduced. A fluid, therefore, will take the shape of any vessel in which it is placed and will have a free surface.

(*b*) A gas is a fluid, the volume of which increases continually as the pressure is reduced—in other words, it is compressible. A gas is, therefore, an elastic fluid. In consequence gas possesses no free surface and will completely fill any vessel in which it is placed.

(*c*) Viscosity or viscidity of a fluid may be defined as the degree of resistance to flow, or tenacity, glutinousness and stickiness. A perfect fluid will have zero resistance to change in shape. The degree of fluidity of various metals and alloys plays a very important part in obtaining sound castings.

Liquids

A liquid at rest cannot exert a pull or tangential force. Therefore, the forces to be considered are those of thrust. A thrust across a unit area is called pressure. If the thrust across every square inch of an area is the same, it is not difficult to find the pressure across the area if the thrust across one square inch is known.

When a fluid is at rest the pressure at any point is perpendicular to the surface with which it is in contact. The pressure of a fluid at any point is the same in all directions, pressing equally in all directions, not only from the top to the bottom like a solid body, but also exerts a pressure laterally in proportion to the height and weight of the fluid. Pressure increases uniformly with depth increase below the surface and varies as the depth. Pressure applied to the surface of a fluid is transmitted without change of intensity to all parts of the fluid.

The force a liquid exerts on the base of a vessel is independent of the shape of the vessel, and depends only upon the area of the base, depth, and specific gravity of the liquid. With a body placed in liquid, every small area of the surface of the body in contact with liquid acted on by force will vary with the depth of the area below the surface of the liquid. One can imagine a body below the surface of a liquid consisting of a fluid of the same density as the liquid itself and its equilibrium under the action of its own weight and fluid pressure. The weight of the liquid displaced by the immersion of a solid body in a fluid is equal to the weight of the solid body. The centre of gravity of the liquid is called the centre of buoyancy, or the centre of gravity of the fluid displaced. The buoyancy of a liquid on a body does not depend upon the depth the body is immersed, provided that the specific gravity of the liquid does not vary.

Gases

Gases are described as elastic fluids. If a quantity of gas is placed in a closed vessel of any size, it will extend itself to all parts of the vessel. This capacity of expanding indefinitely is a peculiar property of gas by which it is distinguished from a liquid. A liquid when placed in a vessel will acquire the form of the portion of the vessel it occupies, according to the law of gravity, but there will be no appreciable change in volume. Since any fluid (liquid or gas) exerts pressure at every point of surface with which it is in contact, it follows that gas will exert pressure at every point of the vessel within which it is contained, whereas a liquid will not exert pressure on the upper surface of a containing vessel within which it is contained if the vessel is not completely filled, the upper surface of the vessel being free. The volume of a given mass of gas under constant pressure increases uniformly with increase in temperature and the amount of increase for all gases when expanding under rising temperature is equal 1/273 part of their volume at 0 deg. C.

FLUID PRESSURE IN MOULDS

The pressures to be considered in a mould are, firstly, that of liquid pressure, which embraces static and streaming pressures or momentum, and, secondly, gas pressure. Usually calculations are based on liquid pressure, but whilst gas pressures are difficult to ascertain, it is a force which must not be ignored, otherwise failure may follow. When moisture in a mould is converted to steam and gas and the temperature further raised quickly in contact with molten iron the increase may be of the order of several thousand times the original volume, depending upon the temperature gradient.

The sand of a mould will hold gas-forming elements in, such as metallic oxides, combustible material and more or less moisture to which must be added the air occupying the mould cavity. A large portion of the gas formed will be evacuated through the sand pores and artificial vents provided by the moulder; further quantities of gas pass through the riser gates, but at the moment of complete filling of the mould, when the riser gates are just closed by the metal, gas pressure will exert a force in addition to that of liquid pressure. The degree of this pressure can only be allowed for empirically from acquaint-

ance with the construction of moulds against fluid pressure. The author would suggest a minimum allowance of an additional 10 per cent. of lift on an average mould for gas pressure. In some cases, such as in certain types of moulds with open risers the gas pressure may be almost nil, but in another class of mould the gas pressure may be more than the 10 per cent. allowance suggested.

When considering the pressure exerted by a molten metal on a mould, the specific gravity of the particular metal is ascertained in addition to the greatest height of the head of metal and surface areas. Any pressure exerted will depend upon the height of the column of metal in the down-gate and pouring basin and not upon the actual volume. With a molten metal, however, the time during which it remains liquid is also important since pressure can only be maintained to act through feeding heads to allow for liquid shrinkage, if the area connecting the header with the casting has sufficient body and volume and delays freezing until the casting is satisfied.

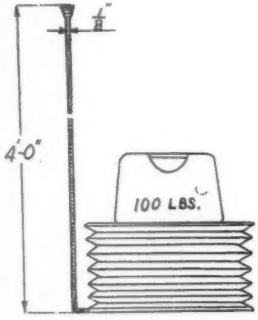


FIG. 1.—HYDROSTATIC BELLOWS.

Actual pressure is easily explained by a reference to a simple U tube with one leg having a 1-in. diameter and the other a 6-in. diameter. Water poured into the 1-in. section will rise into the 6-in. section and remain at the same level in each section. A typical example is that of the hydrostatic bellows, the sketch, Fig. 1, showing how a small quantity of water is capable of exerting great pressure. If a small quantity of water is poured into the ¼-in. diameter pipe which is connected with the bellows, the boards united by leathers will at first open a little, then when weights are placed upon the bellows and water poured in continuously until the ¼-in. diameter pipe is full through its 4 ft. of length, the weights will be raised. Though the water in the tube may weigh but a single pound, yet the pressure of this small quantity of water upon the water in the bellows will support the weights which may approximate 100 lbs.

Comparative Examples

In Fig. 2 is drawn a series of castings whose surface area varies, but which are all poured from a gate with the same head height. A is the down-gate of 1 in. square section fed from a pouring basin, R. The top of the pouring-bush metal is 12 in. above

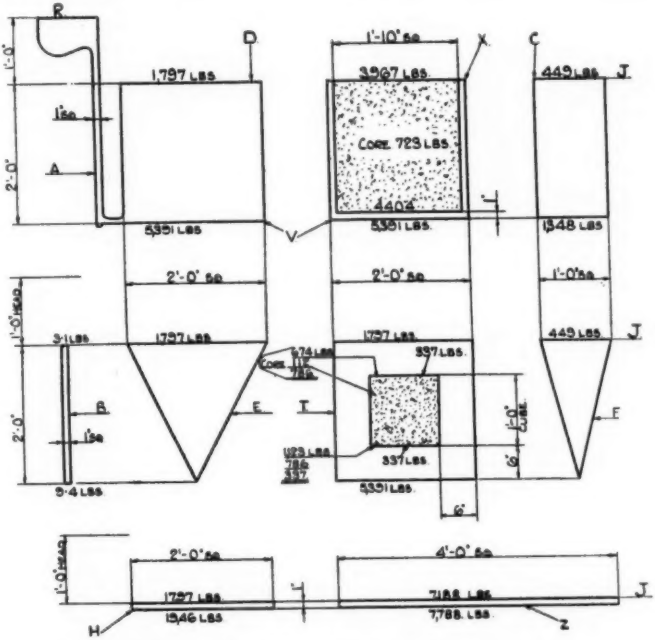


FIG. 2.—SERIES OF CASTINGS WITH DIFFERENT SURFACE AREAS.

Though the examples H and Z depict plates 1 in. in depth; again in each case the castings are subject to the 12-in. head from the joint face to the upper surface of the pouring basin R. An average grade of cast iron is chosen to exemplify fluid pressures. Pressures will vary according to the densities of the alloy or metal. For other metals multiply the cast iron calculations by the factors in

Fluid Pressure

Table I. Taking cast iron at 0.26 lb. per cub. in., pressures are as shown in Table II.

It will be noted that the pressure on the upper faces of D, E, T and H are equal, although the volume of metal varies widely. The pressure on the upper faces of C and F are equal. The mean pressure on the sides of B, C, D, E, F, T and X is 6.24 lbs. per sq. in. The lift on the 12-in. cube core shown in example T is 337 lbs.; therefore requiring an additional force of 337 lbs. minimum to hold the core in its required position in the mould. It has been assumed in this example that the core is surrounded by metal. Of course, this is not practicable since an outlet from the core will be required to conduct away gases. It does, however, allow of a simplified expression of the influence of pressure.

When calculating the fluid pressure on moulds and cores, it is necessary to allow for the generation of the rapidly-expanding gases. An average of 10 per cent. is needed for gas pressure. The momentum of the metal when meeting upper faces of a mould needs further additional allowance of from 5 to 20 per cent., depending upon the open area of the mould and the speed of pouring. Flash formed on mould joints will increase the lift on the top box. When metal escapes from a mould joint the effect is to increase the lift progressively with the spread of the additional area covered by the flash or fin formed. Therefore, between 20 to 25 per cent. should be added to the calcu-

TABLE I.—*Factors for Various Metals.*

Steel, multiply by	1.09
Lead, multiply by	1.58
Leaded bronze (10 per cent. lead), multiply by	1.25
Phosphor bronze, multiply by	1.20
Gun metal, multiply by	1.18
Brasses, multiply by	1.16
Aluminium bronze (10 per cent. Al), multiply by	1.08
Average aluminium alloy, multiply by	0.37
Average magnesium alloy, multiply by	0.24

TABLE II.—*Pressures Imposed at the Points shown in Fig.* 2

Location of area of pressure.	Calculation.	Pressure, lbs.
B.—Section on the upper face at the joint J	1 in. by 1 in. by 12 in. by 0.26	3.12
B.— „ „ bottom of the mould	1 in. by 1 in. by 36 in. by 0.26	9.36
C.— „ „ upper face at the joint J	12 in. by 12 in. by 12 in. by 0.26	449
C.— „ „ bottom of the mould	12 in. by 12 in. by 36 in. by 0.26	1,348
D.— „ „ upper face at the joint J	24 in. by 24 in. by 12 in. by 0.26	1,797
D.— „ „ bottom of the mould	24 in. by 24 in. by 36 in. by 0.26	5,391
E.— „ „ upper face at the joint J	24 in. by 24 in. by 12 in. by 0.26	1,797
F.— „ „ „ „ „ „ J	12 in. by 12 in. by 12 in. by 0.26	449
H.— „ „ „ „ „ „ J	24 in. by 24 in. by 12 in. by 0.26	1,797
H.— „ „ bottom of the mould	24 in. by 24 in. by 13 in. by 0.26	1,947
T.— „ „ upper face at the joint J	24 in. by 24 in. by 12 in. by 0.26	1,797
T.— „ „ bottom of the mould	24 in. by 24 in. by 36 in. by 0.26	5,391
T.— „ „ top of the 12-in. core	12 in. by 12 in. by 18 in. by 0.26	674
T.— „ under the 12-in. core	12 in. by 12in. by 30 in. by 0.26	1,123
	Weight of core and pressure above core	112
		674
T.— „ „ force or pressure required to hold the 12-in. core and prevent flotation		337
X.— „ „ upper face at the joint J	24 in. by 24 in. by 12 in.—22 in. by 22 in. by 12 in. by 0.26 and weight of core at 723 lbs.	3,967
X.— „ „ bottom of the core		4,404
X.— „ „ bottom of the mould		5,391
Z.— „ „ upper face at the joint J	48 in. by 48 in. by 12 in. by 0.26	7,188
Z.— „ „ bottom of the mould	48 in. by 48 in. by 13 in. by 0.26	7,788

lated pressure for variables and contingencies. When boxes or moulds are clamped or bolted together the factor of safety can be very large.

The effect of pressure on a weak and insufficiently rammed and reinforced mould is seen daily in any class of foundry. It will be noted that the pressure exerted on the bottom face of the 24-in. cube, example D in Fig. 3, is over 2¼ tons, and the pressure on the bottom face of the 4-ft. by 4-ft. by 1-in. plate, example Z (Fig. 2), is nearly 3¼ tons. The tendency for moulds to strain at points such as V in the example D, X and T, is pronounced, and must receive special attention to avoid a misshapen casting or even a complete run-out from the mould.

Influence of Fluid Pressure on Soundness

The pressure of the fluid head of metal has a very important effect on soundness in all metals. The greater the height of the fluid head of metal in the runner or riser gates, the greater the possibility of soundness in the casting. Whilst head pressure has little effect on refining or closing up the crystal structure of the metal, the influence on soundness is marked. It is due to the elimination of gases and gas pressure inside the moulds and cores. The head pressure forces gases to evacuate more effectively and speedily from the mould cavity through the riser gates, or pass through the natural and artificial vents provided in the mould and cores. This evacuation must take place before the metal has solidified in the runner, riser or feeder gates connections, so that metal may feed forward to take the place of the spaces occupied by gases under pressure.

The late evacuation of gases from moulds and cores is a greater cause of unsoundness than has yet been acknowledged or recognised by the average foundryman. If gases are slow to evacuate from a mould, the natural feed from the gates may be interfered with, due to a prior freezing of the metal in the gate connections. Finally, when the gas has vacated the various mould and core areas charged with gases, it may result in either distinct depression on the face of the casting or porosity may be disclosed after machining or when subjected to water or air pressure. Foundrymen will be impressed with the improvement to be made by applying the combination of ample head pressure in conjunction with generous gas outlets in moulds and cores, especially in difficult castings with complicated coring and design.

Influence of Atmospheric Pressure

Under this heading no one could do better than refer to the work of H. F. Taylor and E. A. Rominski in utilising atmospheric pressure to aid in the liquid shrinkage feeding of steel castings. The success achieved is based on arrangements made in the construction of a feeder head; in particular, on what are termed as "blind risers," so that the fluid metal of the feeder remains under the influence of atmospheric pressure long enough to force metal forward into the casting to replace liquid shrinkage and its tendency to form voids.

Normally, feeder heads are superimposed above the area of the casting to be fed and usually reach through to the top surface of the moulding box or feeder-head basin. The law of gravity is then allowed to function to force metal into the solidifying casting. To prevent early freezing of the head metal it is usual to cover the surface of the exposed metal with a refractory or a material yielding an exothermic reaction, or by plates placed across the feeder basin. It has not been properly realised, however, that with the covering of the head metal and its retention in the fluid condition over a prolonged period, the

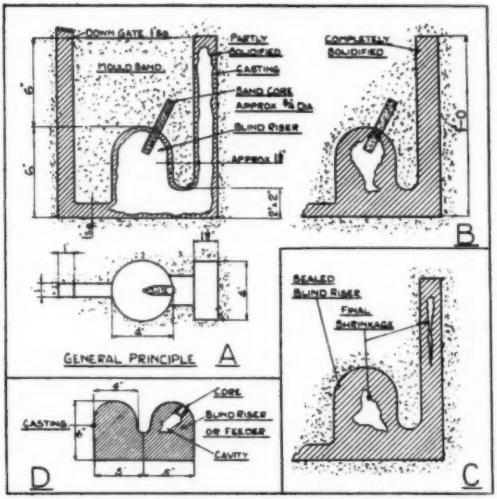


FIG. 3.—TAYLOR AND ROMINSKI METHOD OF BLIND-RISERING. A: Action of control obtained by atmospheric pressure—partial solidification is indicated. B: Complete solidification. C: Type of shrinkage experienced without atmospheric pressure control. D: Showing how the casting section on the left is fed, usually at the expense of the right-hand section which is used as a blind riser.

atmospheric pressure, which is equal to 14.7 lbs. per sq. in., has been acting on the surface of the fluid metal, tending to force it into any voids forming during the shrinkage of the metal of the casting, in addition to gravity. It must be clearly understood that atmospheric pressure cannot function after the formation of a solidified skin of metal completely around the feeder head.

It is usual to locate what are termed "blind risers" (feeder heads) on some part of a casting which cannot be reached by the usual feeders opening to the outside top of the moulding box. This enclosed type

Fluid Pressure

of feeder is known to vary in its efficiency. It is now clearer from the work of Taylor and Rominski why the action of "blind risers" varied. In the description of the methods adopted it will be noted that atmospheric pressure is conveyed to the most fluid and hottest zone of the "blind riser" (feeder) through the pores or interstices of the sand of the mould and an open-grained dry-sand core which communicates with the fluid interior of the "blind riser." The dry-sand core, which acts as the intermediary, is sharpened at the end, which is buried in the metal.

Fig. 3 shows a series of illustrations describing the work of Taylor and Rominski. Small modifications have been made by the writer to the original sketches by the American investigators. The modifications are made for greater clarity. The sectional elevation and plan shown at A, Fig. 3, illustrate, diagrammatically, the principle of "blind riser" feeding; partial solidification is indicated showing the probable heat gradients and freezing tendencies of the metal. The sketch B shows complete solidification and the probable shape and extent of the cavity. Thus, atmospheric pressure has enabled the feeding of metal to a point 6 in. above the height of the "blind riser." At C is disclosed the type of shrinkage which is experienced when the "blind riser" is cut off from atmospheric pressure by the early freezing of the first shell of metal in the "blind riser." D sketch shows how the casting on the left-hand side is fed soundly at the expense of the casting on the right-hand side.

The tests made by the writer, although not yet extensive, largely confirm the work of Taylor and Rominski. Its application appears most effective with metals of short freezing range, such as steel, malleable iron and certain classes of bronzes. The sand for phosphor bronze, however, must be carefully selected, otherwise severe penetration of the pores of the sand takes place and the "blind riser" becomes sealed.

It is obvious that, when harnessing atmospheric pressure in the manner suggested, it is equal to imposing a head height of from 50 to 55 in. in the ferrous alloys, brasses and bronzes and in other metals in proportion to their density. To superimpose such head heights above castings would be an expensive procedure, and in most cases difficult in the extreme. Yet, on the other hand, the new "blind riser" method compels the use of larger boxes in many cases, and in other instances the head metal and fettling are in excess of the standard methods.

Strength of Moulds to Resist Fluid Pressure

A reference to the photographs and sketches shown in Figs. 6 to 10 and the associated data on the stresses upon a mould emphasise the importance of providing suitable moulding tackle, and the fullest recognition of the effects of both the tackle and the work of constructing and consolidating a mould to withstand the stresses imposed by the fluid head of metal.

The effects of weak mould construction may influence the cost and quality of castings in a number of ways:—

(1) A complete failure to hold the metal in the mould means a loss of work equal to a casting minus the cost of dressing.

(2) Partial failure, such as a leakage of metal which is subsequently arrested and the mould finally poured may mean, if the casting is of any importance, that it may be rejected after having passed through important machining operations and tests. When a leakage occurs there is a strong tendency on the part of the caster to allow the head of metal in the pouring bush to sink, or he may make a complete arrest in the pouring operation to allow the leakage to either conjeal or to be stopped by emergency methods. Of course, in either case, dirt will probably have entered the area of the casting. Further, the arrest of the metal may allow partial solidification of the first metal admitted to the mould and when the secondary metal is passed into the mould, seams of imperfection can be noted at about the point where the upward flow of metal was arrested. If the flow of metal is arrested in such castings as liners or pistons one can anticipate a rejection. After machining a distinct line of dirt, blowholes and porous metal will be clearly seen at the point where the metal was arrested—even though the stoppage be only comparatively brief. After due considerations of the case, the casting should in most cases be rejected in the foundry and in the majority of cases without the slightest hesitation.

(3) The shape and scheduled weight of a casting are altered if a mould is strained. The stress imposed by the fluid head of metal will press into weakly rammed areas of a mould, it may be only local with its consequent disfigurement, or it may be general over the whole area of a mould, especially the bottom face of it. In the latter case a considerable increase in the section may result. A general or even local retreat of the sand face before the metal may prove disastrous. A core may have its print on the bottom face of the mould, and if the base of the mould is pressed down by the force of the metal the metal may pass under the core and into the core vents. This failure will probably occur just at the moment when the full head pressure is exerted, just when pouring ceases, and the core will have become bouyant.

Camber allowances can be vitiated if the mould is strained because the extra metal is not allowed for in the considerations and calculations for camber allowances. The additional metal may create extra work and difficulty in the machine shops, especially when such castings are machined in jigs. The extra material machined off swollen surfaces will affect an increase in the exposed grain size and Brinell values of the metal.

Strength of Cores to Resist Fluid Pressure

It sometimes happens that a core fractures completely under fluid pressure, due to weak core rein-

(*Continued on page* 52.)

SECONDARY METAL FOR NON-FERROUS CASTINGS

As virgin copper, tin and zinc are strategic metals to-day, and little, if any, are available in the manufacture of brass and bronze ingots, the source of alloys used in armaments manufacture is from ingots made almost exclusively from the refining of available scrap, points out W. ROMANOFF in a Paper recently read at the annual meeting of the American Institution of Mining and Metallurgical Engineers. In the manufacture of ingot, scrap is collected at various sources and is delivered to the refiner, usually sorted although not always. In working toward a specified chemical analysis, weighed amounts of various grades of scrap metals are melted, and then oxidised by blowing air through the molten bath to rid the metal of detrimental impurities or reduce them to within specification limits, after which they are skimmed off with the aid of some added fluxes. The bath of metal is then poled with wood, chemically tested before and after additions are made to bring it up to the required specifications, and finally poured into ingots, after which a final chemical and physical examination is made.

As above mentioned, the impurities have either been eliminated or reduced to the point where they meet the specifications of all government agencies or technical societies. Therefore, why worry as to whether castings are to be made from strategic virgin metals or secondary ingots from available scrap? Tests have continuously been made, and it is a fact that physical properties are no better from virgin metals than from secondary ingots of the same composition. It is definitely more foolproof to make castings from secondary ingot than from virgin metals because if an error is made in weighing the copper, tin, lead or zinc, of the latter, the analysis is off balance. If an error is made in weighing secondary ingots, one merely has more or less metal, but the analysis remains constant.

In addition, when pure copper is melted, it is susceptible to reducing gases as well as oxides. Secondary ingot is already alloyed with natural deoxidisers, such as zinc, etc., and the volatilisation of the latter also tends to eliminate reducing gases mechanically.

Turning to the vulnerability of some of the common alloys in regard to availability of raw materials as against their relative foundry practice, the author said that alloys such as 88-10-0-2 (S.A.E. 62) with 0.2 maximum lead, 88-8-0-4 (Navy G) with 0.3 maximum lead. and similar alloys are very vulnerable as they require approximately 25 to 30 per cent. of virgin copper and 6 to 8 per cent. of virgin tin in 88-10-0-2 and 5 to 6 per cent. virgin tin in 88-8-0-4. In referring to virgin copper used in the various alloys, one must think of No. 1 scrap copper as such as this item is almost as difficult to obtain as copper ingots.

If possible, it is best to substitute 87-8-1-4 for the above alloys for structural work and either 88-6-2-4 (Navy M) or 85-5-5-5 for pressure castings. No virgin copper is required for these alloys. They are made from smelting copper, light copper and other copper-tin bearing scrap. The 87-8-1-4 requires about 3 to 4 per cent. of virgin tin, the 88-6-2-4 about 2 per cent. of virgin tin, and 85-5-5-5 no virgin tin.

All of these alloys are readily castable and require no unusual foundry technique. There is such little difference between the physical properties of the 88-8-0-4, 87-8-1-4 and the 88-6-2-4 that for all practical purposes they are the same. The average of a number of test bars pulled shows the following results:

	Tensile Strength	% Elong. in 2 in.
88–8–0–4	19.1 tons per sq. in.	32.6
87–8–1–4	18.7 ,,	35.6
88–6–2–4	18.6 ,,	36.4

Red and Leaded-Yellow Brass

In the red brass group, 85-5-5-5, 81-4-6-9 and similar alloys can be included. They should be used wherever possible, as no virgin metal is required, and there is plenty of available scrap for manufacturing the ingot. In addition, the foundry practice for these alloys has been highly simplified, and castings made from same can withstand considerable pressure.

The ingots for the popular alloys in the leaded or yellow brass group are made from all scrap, which in general is quite available. These alloys are gaining in popular usage for low pressure and structural castings which previously had been made from the higher copper alloys. Included in this list are fire-hose couplings, flush valves, and other low-pressure valves and fittings.

Unfortunately, this alloy does not cast as well as the red brass or high-tin/low-lead group. It is not as fluid, and it is much more difficult to obtain clean castings with it. The yellow brasses also give off considerable zinc fumes, which are a health hazard and also tend to slow up production.

Leaded Bushing and Bearing Alloys

The popular alloy in this group has always been the 80-10-10 alloy, but due to the fact that about 2 to 3 per cent. of virgin tin is required in the manufacture of its ingot, it is gradually being replaced by 83-7-7-3 or 80-7-10-3 alloys. These latter alloys require no virgin metals, and there is also plenty of available scrap for the manufacture of the ingot. Several authorities would prefer the latter alloys to the 80-10-10 even though there were no advantages in availability. The 83-7-7-3 has better impact value, but is less resistant to pounding than the 80-10-10 alloy. There are no particular foundry difficulties in casting any of these alloys.

Manganese Bronzes

The war has brought these alloys into considerable prominence. From a peace-time figure of less than 1 per cent. of ingot production, they have increased in tonnage to between 20 and 25 per cent. at the present time. These alloys combine strength and hardness with resistance to sea-water corrosion. No

heat-treatment is necessary in order to obtain high physical properties. In general, there are three popular types of this alloy, as follow:

	Minimum Ten. Sgth.	Minimum Elong. in 2 in.
High strength	44.7 tons per sq. in.	10%
Low strength	29 ,,	20%
or		
Propeller type leaded	26.8 ,,	20%

The high-strength manganese bronze is a very strategic alloy, and approximately 30 to 40 per cent. of virgin copper is required in the general methods of ingot manufacture. It is very brittle when hot and is liable to intercrystalline cracking if subjected to stress while in contact with saline, ammoniacal or acid solutions. The low strength or propeller-type manganese bronze requires little or no virgin copper, while the leaded manganese bronze requires no virgin copper, and there is plenty of available scrap for the manufacture of ingot to meet the latter two types. From this it is obvious that degrading of manganese bronze is necessary, wherever possible. If this had been done, it would not have been necessary to convert manganese bronze castings such as certain propellers, hemisphere castings, etc., into iron. Special foundry practice must be employed in the casting of manganese bronze as it is a high shrinkage alloy and large risers are required.

Silicon and Aluminium Bronzes

In order to conserve tin, silicon bronzes have been considered as a substitute for the high-tin bronzes, but due to the fact that they require approximately 80 to 90 per cent. of virgin copper, it was deemed advisable to find other emergency alloys, with the result that the silicon bronzes are finding small usage in the non-ferrous casting industry at the present time.

Silicon bronzes do not cast as readily as the red brass alloys, but still they would not be considered difficult. As silicon is a harmful impurity in the leaded bronze pressure alloys, the foundryman has been hesitant in accepting silicon bronze casting work, due to the danger of contaminating his other alloys with silicon bronze gates, sprues, borings, etc.

Aluminium bronzes are made from practically all virgin metals, and are therefore avoided wherever possible, but they do have their field in the industries where corrosion, strength and wear resistance are vital factors. These are probably the most difficult alloys to cast in the non-ferrous field, as the alloys have high shrinkage, thereby requiring large risers, and the metal is also very drossy if excessive care is not taken to avoid turbulence in pouring.

In general, when the tin content of brass and bronze alloys is higher than the lead content, the alloy becomes restrictive, as certain percentages of virgin metals are required. The greater the differential between the tin and lead, the more restrictive it becomes. Therefore, one should try to use alloys where the lead content balances the tin content or is even greater, and thus enter the field where there is plenty of available scrap to manufacture the brass and bronze ingot necessary, concluded the author.

NE STEELS MODIFIED

The unexpectedly greater amounts of nickel content in scrap now available in the United States have led to modifications being made in the composition of National Emergency steels. The average nickel content of scrap has been steadily increasing, due partly to the influx of new nickel-containing steel scrap arising from the ever-increasing production of war materials. Consequently, many steel mills find it virtually impossible to hold the nickel content of some of the NE steels below 0.60 per cent. as originally specified for many of these grades. There is not available sufficient carbon-steel scrap low in P and S content to dilute the high nickel scrap.

This condition, says "Steel," prevented production in many mills of the NE 9400 series steels which have a specification limit of 0.20 to 0.40 per cent. nickel and resulted in "off-analysis" heats in the 8600 and 8700 series. The high nickel content of the scrap in recent weeks has often prevented alloy steel producers from bringing heats of NE steels within the specified compositions, resulting in last-minute switches of heats already in process to steels of higher specified nickel content. This has frequently resulted in the use of excess virgin nickel and sometimes of Cr and Mo as well, than would have been necessary if the original intent had been to charge nickel scrap to produce high-nickel steels.

In certain NE steels the upper limit of nickel is being increased by 10 points in the 0.40 to 0.60 per cent. range and by 0.10 per cent. in steels of 0.20 to 0.40 per cent. and 0.40 to 0.60 per cent. nickel, the two ranges respectively now being 0.20 to 0.50 and 0.40 to 0.70.

FLUID PRESSURE IN FOUNDRY PRACTICE

(*Continued from page* 50.)

forcements. It may be that the use of studs or chaplets is prohibited in a casting with a horizontal core of a comparatively lengthy nature and, if the core is weak, and other means of holding the core are not taken, the core bends, resulting in irregular sections. The failure of the core may be quite obvious or it may not be disclosed except by a distortion of the casting due to the uneven sections.

Metal may force its way through a softly rammed area of a core into the vent, and in the case of a loam core, through a too-thinly-applied loam coating around hay or straw lapping. It is not unknown for the loam thickness to be lifted bodily upwards by the metal because the straw or hay lapping has been incorrectly applied, or it has been charred by drying the core at too high a temperature. Loam cores placed in moulds poured on end, such as for hydraulic cylinders and ram castings, may fail, if not very soundly constructed. The high fluid pressure on the lower end of the core may squeeze in the core material. In such cases, the use of straw and hay lappings is omitted about the lower end of the core.

(*To be continued.*)

INSTITUTE OF BRITISH FOUNDRYMEN

LONDON BRANCH ANNUAL MEETING

The review of the work of the past session of the London Branch of the Institute, presented at the Annual General Meeting of the Branch on Thursday, April 29, at the National Liberal Club, Whitehall Place, S.W.1, showed many features giving cause for congratulation, not the least of which was the rapid growth of membership, reflecting as it does the ever-expanding interest of the foundry industry in the work of the Institute. Mr. R. B. Templeton (retiring Branch-President) was in the chair.

Annual Report

MR. V. C. FAULKNER (Branch Hon. Secretary) presented his report on the work of the Branch during the session 1942-43, as follows:—

Technical.—Since the last Annual General Meeting, which included the presentation of the First Foundry and Metallurgical Brains Trust, eight meetings have been held. Mr. Cherry Paterson dealt with mechanical handling in foundries in May; Mr. J. H. Williams, B.Sc., opened a discussion on "Ladle Metallurgy" in August, and Mr. J. W. Gardom detailed the manufacture of tank tractor links in September. These meetings were held on Thursday evenings, and the average attendance was 34. The meetings for the balance of session were held on Saturday afternoons, at which the attendance showed a continued improvement and averaged 46. This part of the Session opened with a discussion on fuel economy led by Mr. F. Hudson and Mr. A. E. McRae Smith. A valuable contribution was made by Capt. Bennett, of the Ministry of Fuel and Power. The October meeting was addressed by the Secretary, because of the sudden illness of Mr. Burgess. His subject was the "Future of the Foundry Industry." In January, Mr. W. Gladwell demonstrated the practical use of radiography to the foundryman, whilst in February, Mr. A. Burgess gave the Paper he promised for the October meeting on the "Manufacture of Small Engineering Castings." The final meeting, which attracted over 100 members and visitors, was held in the lecture theatre of High Duty Alloys, Limited, at Slough. Mr. E. W. Harding read a Paper on "Gating," which he illustrated by coloured films and slides. After tea, kindly provided by the hosts, members were conducted round the magnificently-equipped research laboratories.

Membership.—During the year Branch membership has grown to 403, made up of three honorary members; 15 (10) subscribing firms; 237 (215) members; 146 (139) associate members, and 2 (2) associates. This shows a net gain of 41, despite the fact that the Branch has lost six members to the newly-formed Bristol Section.

East Anglian Section.—The Section under the chairmanship of Mr. C. J. Lake has continued to progress. Though suffering a slight decline in membership, its technical and educational activities have increased. Its members have co-operated with the Ipswich Technical College, and with the local Fuel Economy Committee. The Council is sorry to report the resignation of Mr. J. L. Francis and wish him every success in his new sphere. Mr. A. N. Sumner has been elected in his place.

Distinction.—Mr. L. W. Sanders, who presented a Paper in collaboration with Mr. C. H. Kain before the annual meeting of the Institute, has been awarded the Diploma of the Institute.

Fuel Conservation.—The Branch has been represented on the London, Southern and South-Eastern Panel of the Ironfoundry Industry Fuel Committee, of which the President is chairman. It has met monthly, and has made greater progress than was anticipated by the parent body.

The year has seen the Branch grow into the largest in the Institute, and this fact was recognised by the Council offering to the President (Mr. R. B. Templeton) a complimentary luncheon before its December Council meeting. The function was presided over by Mr. D. H. Wood, the Vice-President of the Institute, and letters of congratulation were received from Major Miles, the President, and Mr. T. Makemson, the Secretary of the Institute. The success of the last two years is very largely due to the efforts made by Mr. Templeton.

Finance.—Mr. V. Delport (Joint Auditor) presented the accounts for the year 1942, and gave details of income and expenditure. He emphasised that the total subscriptions received during the year amounted to an all-time record. The expenses of operating the Branch were at £60, roughly the same amount as last year.

The satisfactory nature of the report was commented upon by the Branch-President, and on his proposition it was unanimously adopted.

Election of Officers, 1943-44

The CHAIRMAN, proposing the election of Mr. H. W. Lockwood as Branch-President, recalled his great services to the Branch before the war as Hon. Secretary, and later as a Vice-President. No doubt he would have succeeded to the Branch-Presidency two years ago, but for the fact that he had been transferred to the Black Country. He had given more years of service to the Institute than probably he would care to remember; in his work as Branch Hon. Secretary for many years he had been indefatigable. Further, he was not a man to look for reward.

MR. BARRINGTON HOOPER, C.B.E. (Past Branch-President), seconding, said it was a distinct privilege and pleasure to do so; indeed, the Branch was lucky to have a man of Mr. Lockwood's standing willing to accept the Branch-Presidency in a war year, for in wartime it involved a great deal of hard work and there were less kudos in it than in peacetime, there being no social functions and conventions. He would need all his abilities, great as they were, to emulate so outstanding an example as that set by Mr. Templeton. However, the members had no doubts about the success that he would achieve.

Mr. Lockwood was unanimously elected.

Other officers elected were:—*Senior Vice-President:* Mr. A. J. Murphy, M.Sc.; *Junior Vice-President:* Mr.

Institute of British Foundrymen

J. F. Kayser, Assoc.Met.; *Members of Council:* Mr. B. B. Kent, Mr. P. D. Pincott, and Mr. F. J. Wares. *Hon. Secretary:* Mr. V. C. Faulkner; *Hon. Auditors:* Mr. C. Cleaver and Mr. V. Delport; *Delegates to General Council:* Mr. C. C. Booth, J.P., Mr. B. B. Kent, Mr. R. B. Templeton and Mr. C. H. Kain; *Representatives on Technical Committee:* Mr. A. J. Murphy and Mr. C. H. Kain.

Vote of Thanks to Retiring Officers

MR. MCRAE SMITH proposed a very hearty vote of thanks to the retiring officers and members of Council. They had done, he said, a very great deal of good work; the members of the Branch were very much in their debt and were very grateful. Such a motion, he added, would need no seconding.

The vote of thanks was accorded with enthusiasm.

The CHAIRMAN, replying on behalf of himself and his fellow officers and members of Council, said it was a pleasure to serve so progressive a body. He personally was rather sad about vacating the presidency after two years in that office, for he had thoroughly enjoyed his term of office; it had been great fun to watch the Branch expand and to note the interest of the members in the proceedings. After all, it was only through the members that the Institute could progress, and the members had shown remarkable interest, despite the facts that the fare offered them was necessarily restricted under war conditions, that travelling was inconvenient and that they were all working very much harder than they were five or six years ago. He hoped their interest would continue and that the Branch would continue to grow.

Presentation of Institute Diploma

The CHAIRMAN formally presented to Mr. L. W. Sanders the Diploma of the Institute, awarded for a Paper, of which he was joint author with Mr. C. H. Kain, on "The Production of Uniform Steel for the Light Castings Foundry," presented to the annual meeting of the Institute in 1942. The Chairman congratulated Mr. Sanders and wished him good fortune in the future.

MR. SANDERS, expressing his thanks, said it was due to the help he had received from Mr. Kain that he was able to write the Paper, and, in his view, the Diploma should have gone to Mr. Kain. But. Mr. Kain was already a holder of the Diploma, and, therefore, it had been awarded to himself. But he was none the less grateful for and conscious of Mr. Kain's collaboration.

Short Paper Competition

Four short Papers were submitted in competition. They were read by Dr. A. B. Everest, and the meeting was asked to adjudicate as to which was the best. The names of the authors were not disclosed until

(Continued at foot of next column.)

RADIOGRAPHY AS AN AID TO FOUNDRY TECHNIQUE

(Concluded from page 57.)

his experience they could eventually produce good castings, no matter what type they were, if they tried hard enough and long enough and had the advantage of X-ray examination. X-rays could also be used as a method of inspection, but in his view that use was not to be encouraged. It was expensive and totally unnecessary, because its use by the founders had already ensured that the castings were good.

The BRANCH-PRESIDENT, at the conclusion of the discussion, said it was useless making a really good metal, and then spoiling its value by faulty foundry technique. The value of X-ray examination was that it enabled foundrymen to ensure that their technique was good, for it was a final arbiter of the soundness of the castings. A test-bar might show that the metal had a tensile strength of 20 tons per sq. in., but if there were porosity in the casting, it was not up to specification.

Vote of Thanks

MR. FAULKNER, proposing a vote of thanks to Mr. Gladwell for his Paper, congratulated him on the fact that he was the first practical foundryman to present a Paper on the radiographic examination of castings. He also expressed thanks to Mallory Metallurgical Products for giving Mr. Gladwell facilities for his Paper, and to his colleagues in that firm for their willing assistance in connection with it.

DR. L. HUNT, who was instrumental in securing the Paper, seconded the vote of thanks. He pointed out that the initiative had come from Mr. Gladwell, who had urged the use of radiography, and had played a leading part in developing its use during the last two or three years by his company as a foundry tool, and not as an acceptance test; neither he nor the company had put it forward as an acceptance test. As was pointed out in the Paper, gamma radiography was used in the foundry as a guide in the production of better and sounder castings.

The vote of thanks was accorded with acclamation, and the meeting closed.

(Continued from previous column.)

after the members had voted. A prize of £3 3s. was offered by Mr. Templeton to the author of the Paper which received the greatest number of votes; and, in view of the fact that the voting was so close, Mr. Barrington Hooper offered a consolation prize of £2 2s. to the runner-up. The prize of £3 3s. was awarded to Mr. V. C. Warren, Associated Member (foundry foreman, Messrs. Booth & Brooks), for his Paper on "The Study of Shop Wasters and Their Causes." The second prize of £2 2s. was awarded to Mr. J. P. P. Jones (Messrs. Foundry Services, Limited) for a Paper entitled "A Brief Review of the Production, Melting and Casting of Magnesium."

RADIOGRAPHY AS AN AID TO FOUNDRY TECHNIQUE

Gamma-Rays in the Routine Testing of High-Conductivity Copper-Alloy Castings

By W. GLADWELL

(*Continued from page 27.*)

Blowhole Detection

Commenting on whether or not one could detect a cavity in a casting by means of X-rays, Mr. Kayser said the answer did not depend on the absolute size of the cavity; it was a matter of the size of the cavity relative to the thickness of metal in which it was enclosed. In the examination of light alloys a careful operator could detect a change of section of only 2 or 3 per cent. It might not be an abrupt change of section due to the presence of a blowhole; it might be due to porosity, and one needed a good deal of experience in the interpretation of results to be able to detect the difference between a general porosity and just one blowhole or cavity.

It was rather difficult to determine the position of blowholes or cavities with the aid of only one shot, because there might be two cavities, one above the other; in a normal shot one could not determine their position by the intensity, nor could one determine the dimensions, because the two cavities would register as one.

As to whether or not X-ray pictures should be used for the purpose of acceptance tests, he agreed with Mr. Faulkner that they should not be so used, in the present state of our knowledge and the state of the art. At the same time, it was valuable as an aid to successful production. His own firm bought many castings, but they specified quite definitely what they wanted, so that there was no argument about it; they would not buy certain classes of castings from a firm which had not an X-ray set or, alternatively, which did not use one of the commercial institutions liberally. When dealing with a foundry of repute, one need only specify that the castings required must be suitable for the manufacture of certain products, which might be fireplaces or diesel engine cylinders. If the founders produced castings which were not suitable, owing to the presence of cavities, and so on, it was their funeral. But if the buyer doubted the integrity of the founder, then there should be an acceptance test. He urged that every foundry should have an X-ray apparatus, just so that they should know what they were doing.

MR. GLADWELL agreed that it was not easy to decide the angle from which to take a radiograph of a casting. With regard to a cavity, he had not claimed that one could determine its position from a single radiograph. A second exposure was necessary, and if the time of the second exposure were reduced, the images would have slightly different densities; by moving the apparatus a little for taking the second exposure, it would be sufficiently out of line to show whether or not there were two cavities. But that was purely a matter for the radiographer, and a foundryman did not need to be a radiographer.

MR. DURANT (Johnson & Matthey, Limited), who was invited by Mr. Gladwell to answer the question concerning cavities, agreed that two cavities in line would show as one. But if the image indicated a cavity, one might decide that it was so near the middle of a thick section, and away from any changes of section, that its presence would not matter, from the point of view of the efficiency of the casting in use; and even if there were two small cavities, that fact might not affect the decision. But if a cavity were in an awkward position in the casting, the operator would probably radiograph it from a second angle; then, if there were two cavities, he would detect them, and would be able to decide whether one or both were bad from the point of view of the use of the casting.

MR. R. TURNER (Mallory Metallurgical Products) said that the radiographs exhibited at the meeting had been selected rather carefully, from the point of view of their interest to foundrymen. He agreed that it was important to select the right angle from which to take a "shot," and added that in some cases one could consider just one spot on a radiograph for quite a long time before one could decide whether or not it was necessary to change the method of producing the casting in question.

MR. KAYSER agreed with Mr. Turner, and said he was merely anxious to emphasise that it was important to choose the right angles when using X-ray apparatus.

High-Conductivity Copper

MR. G. C. PIERCE (Branch Past-President) complimented Mr. Gladwell on the fact that, whereas he might have chosen to present a highly academic Paper—which many foundrymen did not like—he had in fact dealt with his subject in a manner which every foundryman could understand. His heart went out to Mr. Gladwell when the latter had mentioned the difficulties experienced in casting really high-conductivity copper. Any foundryman who was making castings in copper of really high conductivity, in the region of 84-88 conductivity (as distinct from copper of ordinary conductivity), would find, not only blowholes, but real cavities in some of those castings; and there was no doubt that they were real cavities. He wished Mr. Gladwell had exhibited a radiograph showing the porosity found ordinarily in high-conductivity copper.

Recently, continued Mr. Pierce, he had been considering the use of the shadowgraph for determining the utility or otherwise of castings, particularly of

Gamma-Radiography in the Foundry

copper, for he supposed that the cost of determining whether or not a casting was thoroughly sound by means of a volume conductivity test would be higher than the cost of a shadowgraph test; the calculations involved in a conductivity test on a highly irregularly shaped casting could be very complex, though it was quite simple to make a conductivity test on a 2-in. sq. bar. A shadowgraph might show whether or not the copper contained anything which should not be there; and there were not too many ingredients that one could use to maintain the conductivity of copper whilst at the same time ensuring the production of sound castings. He asked whether the use of the shadowgraph was an economic proposition in foundries dealing with speciality alloys.

MR. GLADWELL replied that, although he had not shown radiographs illustrating the sort of trouble to which Mr. Pierce had referred, he certainly had some of them; the casting of high-conductivity copper gave rise to a good deal of trouble. Radiography was reasonably cheap; it might be thought that the initial cost of the apparatus was the real difficulty, but that could be dealt with quite well. Before the war it was possible to hire the apparatus, and it was quite useful to be able to do that when dealing with speciality castings.

MR. PIERCE said he believed that very high-conductivity copper castings were designed very much heavier (to ensure that the required conductivity would be achieved) than would be the case if the designers knew that the castings would be completely sound.

MR. GLADWELL agreed that radiography was useful in enabling founders to limit the weight of their castings; and he added that, the heavier the section, the worse the trouble was likely to be.

A Different Perspective

MR. C. H. KAIN (Past-Branch-President), after thanking Mr. Gladwell for having indicated one more step in the direction of the precision inspection of castings, commented that radiographic examination seemed to be still in the stage of diagnosis. Both Mr. Faulkner and Mr. Gladwell had intimated that there must be agreement on permissible flaws; but Mr. Kain disliked that attitude intensely, and expressed the hope that the radiography engineers would soon be able to provide equipment with the aid of which one could guarantee perfect castings. Undoubtedly the secret of quality in castings was rigid inspection.

During the last six months we had witnessed the rather startling developments of the atmospheric head, which was given much publicity in the American Press, and the whirl gate head, which was developed in this country, and the results obtained with the high-shrinkage steels were really quite remarkable. He could see no reason why foundrymen should still be worrying about the permissible flaws as shown in radiographs; they had to make the perfect casting, and it was up to the radiographer to provide an instrument which would give precise information.

He had been told by his friends in the light alloys industry who employed radiography very extensively that they were still, unfortunately, at the stage where they might have to make as many as 500 radiographs of a new part before they could be perfectly satisfied of the correctness of the diagnosis of what they saw on the graphs. It seemed to him that there were two attitudes towards the use of X-rays. The first was illustrated recently, within his experience, when medical men, after studying an X-ray photograph relating to a patient who was seriously ill, had shaken their heads very learnedly and solemnly and had walked away. That, he said, represented the attitude of the foundryman. Then there was the attitude of the engineer, who seemed to think that X-ray examination provided the answer to all questions, though certainly it did not. He could see no difference between the examination of production castings and of jobbing castings. Surely in the course of time there would be available instruments, with a capacity approaching 1,000 kv., which could be installed and used for routine inspection.

Commenting on Mr. Keyser's view that engineers should specify merely that the castings they ordered must be suitable for the job they had to perform, Mr. Kain suggested that that was undesirable, because it meant throwing the foundrymen into the realms of diagnosis as to what was suitable and what was not suitable. Foundrymen must ask for precise information as to the requirements which their castings were to meet; they wanted the engineer to state that the castings he required must meet certain requirements, and must conform to certain measurable constants. X-rays should help the foundrymen to produce the castings required.

Inspection Difficulties

MR. A. J. MURPHY, M.Sc. (Vice-President), uttered the warning that they in the foundry industry would make a great mistake if they tried to transfer to someone else the responsibility for decisions regarding the quality of their castings. The light alloy industry, producing castings for aircraft, had made most frequent use of the X-ray method of inspection, and it was instructive to recall the principle which was followed in that field. Those who signed certificates relating to the X-ray examination of castings for the aircraft industry were required to certify that the castings were free from major defect. The technician of the foundry company had to do that, and if he used the X-ray method for that purpose he must use it in the best possible way. Mr. Murphy added that he did not know of any case in which it was reasonably possible for any outside authority to put forward a precise specification as to the quality of castings as revealed by radiography: one could not define numerically the features one saw in a radiograph. Sometimes in production jobs, where many of exactly the same article were made and where there were many radiographs exhibiting a certain feature, it was possible to correlate that feature with a certain quantitative

deterioration of mechanical properties. But the more experience one had of doing that, the more hesitant one became to do it if it could possibly be avoided.

The Paper had dealt with the radiographing of castings in copper alloys, which were different from the light alloy castings used in aircraft. The latter had generally to withstand stress in use, and it was necessary to know whether they were of sufficient quality to withstand the stress to which they were to be subjected. Presumably that was not so in the case of the castings discussed by Mr. Gladwell, whose purpose was to ensure that those castings would not prove to be defective after expensive machining and would not fail under pressure test.

MR. GLADWELL agreed that that was so. But it was necessary also to ensure mechanical strength, particularly in the case of the switchgear type of castings.

MR. MURPHY, referring to the use of X-rays for checking the quality of new production, said it was important to maintain a balanced mind in regard to that. The great value of X-ray examination was that it was non-destructive; it was an alternative to sectioning and fracturing castings for purposes of examination. There was no particular merit in the X-ray method *per se* as applied to castings; but it had the great advantage, in connection with production, that it was convenient and non-destructive.

Percentage Inspection

Asking for information as to the percentage of the total castings that were X-rayed in any batch, MR. MURPHY said that one sought a method of batching which would give a logical connection between the number that had to be examined and the number that were governed by that examination of the minority. In some cases the practice was to examine radiographically the first 10 or 20 castings or such other numbers as were necessary to obtain 10 consecutive castings free from major defects. That was held to confirm the correctness of the foundry method, and then it was possible to fall back on less than 100 per cent. inspection, the actual percentage depending on the nature of the job.

Emphasising the value of external inspection, coupled with X-ray examination, he said that in very many cases it was possible to see some slight indication, on the external surface, of a defect which would also be revealed, and more clearly revealed, by X-ray examination. His company attached very great importance to the interpreter of the radiograph making also a very close visual inspection of the casting. That visual examination enhanced very greatly the value of the X-ray examination, and gave indications as to where one could concentrate with advantage the X-ray examination. Finally, Mr. Murphy asked for Mr. Gladwell's experience as to the value of the X-ray method for the detection of cracks in castings of pure copper and the copper-rich alloys which he had described.

MR. GLADWELL, replying to the question concerning the percentage of castings that were examined in any batch, said that in the majority of cases with which he was concerned it was necessary only to produce a few in each batch, so that 100 per cent. radiographic examination was possible. But where a considerable number had to be made, the method was to settle the casting procedure with the aid of radiographic examination, and to adhere to that procedure. He had had no experience of the use of radiography for the detection of cracks; when a crack occurred, it was usually one that could be seen quite easily.

A Medical Analogy

MR. P. T. HOLLIGAN recalled that he had been concerned, some years ago, with the examination of welded pressure vessels, having walls about 2 in. thick, and all of them were X-rayed. Incidentally, in that case an acceptance test was adopted by Lloyd's Register, which was the specifying authority, and was accepted by the manufacturers, and it was that fact which had enabled welded pressure vessels to go into service. The purpose of the test was to detect, not only slag inclusions and porosity in the weld metal, but also cracks, and the latter was a matter of very great difficulty. In one particular case there was a crack running parallel to the direction of the rays when the "shot" was made. It was probably only one-tenth of a thousandth (0.0001 in.) wide, and one could not expect to detect it when the rays were parallel with it. A "shot" taken at right angles also would not show the crack, because the actual reduction in density was considerably less than the 1 per cent. which was regarded as the sensitivity factor of X-rays at that time. That experience suggested that it was very difficult to detect cracks by X-rays.

Emphasising the point made by Mr. Murphy concerning the importance of examining the surface of a casting in addition to the radiographic examination, Mr. Holligan recounted the experience of a friend who had been X-rayed. The doctors had pointed to a shadow shown on the shadowgraph and had said that there must be something gravely the matter with him. He had pointed out that he had been X-rayed from the front, whereas a scar was on his back; and the doctors were annoyed because he had not told them about it previously. That story perhaps pointed a moral to those who were radiographing castings!

MR. W. D. GIST, expressing appreciation of the value of the X-ray examination of castings, said that sometimes, when he had exhibited examples of the sort of defects which it detected, the foundrymen to whom he had shown them had expressed thankfulness that their own castings were not X-rayed, because they felt sure that some of their castings would not stand up to it. One valuable use for radiography in the foundry was to enable foundrymen to determine whether or not their method of casting was satisfactory. Inasmuch as it indicated the types of defects, it enabled the foundrymen to try other methods to overcome those defects; and it was not unusual for them to try half-a-dozen different methods before they were able to produce satisfactory castings. In

(*Concluded on page* 54.)

PERSONAL

COL. T. G. GREENWELL, of Cleadon, Co. Durham, has been elected Conservative candidate for the Hartlepools Parliamentary division. He is managing director of the Wear Arc Welding Company, Limited, and T. W. Greenwell & Company, Limited, Wearside shipbuilders.

MR. WALTER R. BAKER has completed 71 years' continuous service with Cyrus Price & Company, Limited, safe manufacturers, Wolverhampton. Starting work with the firm as an office boy in 1872, he was made managing director in 1895, a position he still occupies. Mr. Baker is 84 years of age.

MR. CHARLES G. RENOLD, managing director of the Renold & Coventry Chain Company, Limited, has been appointed chairman of the engineering and metals section of the Manchester Chamber of Commerce in place of Mr. C. Bentham, who has relinquished the office in order to devote all his time as Deputy Director General of Machine Tool Control and as Adviser to the Admiralty in connection with the equipment of shipyards and marine engine works.

MR. CHARLES W. BRIGGS, technical and research director of the Steel Founders' Society of America, Cleveland, Ohio, who is to present the 23rd annual exchange Paper on behalf of the American Foundrymen's Association to the Institute of British Foundrymen, became research metallurgist for the Standard Oil Company, of California, in 1928. Two years later he left to become physical metallurgist, U.S. Naval Research Laboratory, Washington, D.C. While with the Navy he carried out a basic research programme on cast-steel and steel castings. In 1938 he joined the staff of the Steel Founders' Society, which is the trade association of the American steel-castings industry. He is in charge of all technical matters pertaining to the affairs of the Society. Mr. Briggs has published many Papers on cast-steel fundamentals and allied subjects, and is editor of the recently published "Steel Castings Handbook." He has been awarded the William B. McFadden Gold Medal of the American Foundrymen's Association for his direction of important research, and has published writings on metallurgy of great value to steel founders.

OBITUARY

MR. CHARLES STEWART, a director of Johnson & Phillips, Limited, has died after a long illness.

MR. CECIL GEORGE LANGFORD, managing director of George Glover & Company, Limited, gas meter makers, and a director of Fletcher Russell & Company, Limited, and other companies, has died at his home at Esher.

MAJOR ALBERT ROGER SENIOR, third son of the late Mr. and Mrs. Albert Senior, of Sheffield, has been killed in North Africa. Major Senior was 38 and was well known in Sheffield industrial circles before the war, when he was with Thos. Firth & John Brown, Limited.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s each.

552,049 BUDD INDUCTION HEATING, INC. Strengthened cylindrical ferrous metal structures.
552,111 HORNSBY, H. Crucible furnaces.
552,119 INLAND STEEL COMPANY. Burner mountings for furnaces.
552,120 TELEPHONE MANUFACTURING COMPANY, LIMITED, and PADDLE, L. H. Production of metal or alloy powders.
552,126 GENERAL MOTORS CORPORATION. Manufacture of metal tubing.
552,128 HITCHINS, S. Coupling means for uniting lengths of angle-section metal rods, bars, and the like.
552,162 BRITISH ROLLING MILLS, LIMITED, and MORRISON, G. B. Manufacture of steel.
552,234 INTERNATIONAL ALLOYS, LIMITED, and PRYTHERCH, W. E. Apparatus for use in distilling metals by electric induction heating.
552,237 MARINE MAGNESIUM PRODUCTS CORPORATION. Method of manufacturing metallic magnesium.
552,240 EVERY, C. E. (Titanium Alloy Manufacturing Company). Compositions for foundry moulds or cores or composition for coating foundry moulds or cores.
552,254 MAGNESIUM METAL CORPORATION, LIMITED (American Magnesium Metals Corporation). Refining of sublimable materials.
552,311 CROWN CORK & SEAL COMPANY, INC. Coated metal strip material.
552,312 UDY, M. J. Production of solid agglomerates for metallurgical operations.
552,356 MILLSPAUGH, W. H. Method of producing hollow or tubular bodies of steel or other metals and apparatus therefor.

IRON AND STEEL INSTITUTE

Col. Sir W. Charles Wright, Bt., K.B.E., C.B., Acting Controller of Iron and Steel, has been unanimously elected an honorary member of the Iron and Steel Institute. Honorary membership of the Institute is rarely conferred. Excluding members of the Royal family, Sir Charles is only the eighth Englishman to receive this distinction since the first award in 1874. Sir Charles, formerly chairman and managing director of Guest Keen Baldwins, Limited, and chairman of Baldwins, Limited, was President of the Institute in 1933.

The Iron and Steel Institute have awarded the Bessemer Gold Medal for 1943 to Mr. J. H. Whiteley, of the Consett Iron Company, Limited. Mr. Whiteley's study of the acid hearth and slag, and his examination of the nature of inclusions in steel, are two of the most noteworthy contributions made to iron and steel research during recent years. He received the Carnegie Gold Medal in 1917.

NEWS IN BRIEF

A BRITISH INTERNAL COMBUSTION ENGINE RESEARCH ASSOCIATION has been formed.

FOR ACQUIRING 14½ tons of scrap lead without a Ministry of Supply licence, Slugs, Limited, of Bromley, manufacturers of air-gun pellets, were fined £50 with £5 5s. costs.

THE BUILDING INDUSTRIES NATIONAL COUNCIL is to hold a congress of the building industries on July 21 and 22 at the Caxton Hall, Westminster, at which post-war housing will be the main subject under discussion.

AN EFFORT is to be made to increase war savings among workers in the iron and steel trades, according to Mr. George Gibson, a vice-chairman of the National Savings Movement, and member of the T.U.C. Executive.

THE COMPANIES REGISTRATION OFFICE gives notice that the names of the undermentioned companies have been struck off the register, and such companies are dissolved:—B. & B. Metals, Limited; British Metals & Alloys, Limited; British Supersteam Generating Company, Limited; Fuel Savers, Limited; Parallel Motion Tool Company, Limited; T.A.B. Engineering Company, Limited; Traco Machinery Company, Limited.

THE INDUSTRIAL WELFARE SOCIETY'S correspondence course in industrial law has proved of great benefit to many persons who required a working knowledge of industrial law but who could not afford to give a prolonged study to the subject. The course consists of six lectures, each of which can be read in 1 to 1½ hours. Particulars can be obtained on application to the Secretary, Industrial Welfare Society, 14, Hobart Place, London, S.W.1.

QUARTERLY STATEMENTS on unemployment have taken the place of the monthly statements issued hitherto. The number of men and boys registered at employment exchanges in Great Britain as wholly unemployed at April 12 (exclusive of 21,026 men who had been classified as unsuitable for ordinary industrial employment) was 51,216. Compared with January 18, this was a decrease of 7,118. The corresponding figures for women and girls were 25,553 wholly unemployed, a decrease of 9,821.

THE CUMBERLAND IRON ORE MINERS' BRANCH of the National Union of General and Municipal Workers has passed a resolution urging the Ministers of Labour and Supply to institute a rigorous inquiry into the question of ore production in the area. A decline in output is alleged, and the Council of the branch consider that it is unwarranted. The resolution also criticises the Control, and urges the formation of a Central Production Committee under the direct supervision of the Ministry of Supply.

CAPT. J. BRUCE JONES, whose death has occurred from wounds received in the fighting in North Africa, was before the war a director of Jones & Campbell, Limited, Torwood Foundry, Larbert, Stirlingshire. He was also a director of the Scottish Enamelling Company, Limited, Foundry Loan, Larbert.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"RENEX"—Insulated cables. SCOTTISH CABLES LIMITED, Deanside, Renfrew.

"ROMAC"—Metals and alloys. ROMAC INDUSTRIES, LIMITED, The Hyde, Hendon, London, N.W.9.

"TECHNICUT"—Cutting machine tools. WONTOOLS, LIMITED, Audrey House, Ely Place, London, E.C.1.

"TROJAN"—Non-ferrous metal alloys. TROJAN METAL COMPANY, 196, Woodside Avenue, Coventry.

"WEDCO"—Wire mesh work. BRITISH WEDGE WIRE COMPANY, LIMITED, Academy Street, Warrington.

"FINGRIP"—Control valves. TOWLER BROS. (PATENTS), LIMITED, Oaklands Engineering Works, Rodley, Leeds.

"AMARILLA"—Mining machinery, etc. GEORGE FLETCHER & COMPANY, LIMITED, Masson Works, Litchurch Lane, Derby.

"BURFREE"—Nibbling machines. J. B. STONE & COMPANY, LIMITED, 5, Bloomfield Place, New Bond Street, London, W.1.

"VETEX"—Machine belting. HELVETIA LEATHER COMPANY, LIMITED, Turnpike Works, 258, Langham Road, London, N.15.

"HEDDESCO"—Electric soldering irons, batteries, cable and flex. HEDDESCO, LIMITED, 1, Stanhope Street, London, N.W.1.

"THERMEXED"—Electric wires and cables. BRITISH THOMSON-HOUSTON COMPANY, LIMITED, Crown House, Aldwych, London, W.C.2.

"FORTENAX"—Refractory and furnace cement. FOUNDRY REFRACTORIES, LIMITED, 9, Midland Road, Wellingborough, Northants.

"BESCO"—Machine tools; metal working machinery; hand tools. F. J. EDWARDS, LIMITED, 359/361, Euston Road, London, N.W.1.

"LORSOL"—Apparatus for soldering, brazing or welding. LORANT & COMPANY, LIMITED, 98-100, Croydon Road, London, S.E.20.

"SURESEAL" (and Seal Device)—Metal valve plates. J. BROWETT LINDLEY (1931), LIMITED, Coborn Works, Dunhams Lane, Letchworth, Herts.

"SAVAL"—Machine tools, boring bars and chucks, and machine pulleys. J. HUTTON & COMPANY, LIMITED, 1 and 3, Scotland Street, Glasgow, C.5.

"FOWLER" (Circular Device)—Internal combustion engines and compressors. JOHN FOWLER & COMPANY (LEEDS), LIMITED, 13, Leathley Road, Hunslet, Leeds.

"SANDEF"—Hand tools and implements. S. & F. TOOLS, LIMITED, Sandef Works, All Saints Lane, Coventry, and ROBERTS BLACK & COMPANY, LIMITED, 19-21, Brazennose Street, Manchester, 2.

"ASEA"—Machinery for generating electricity, electrically-operated machine tools, electromotors, machine couplings, gears, etc. ASEA ELECTRIC, LIMITED, Fulborne Road, Walthamstow, London, E.17.

"TEWEL"—Split cotter pins; nuts and bolts; plain and spring washers (metal); wire for non-electrical purposes, etc. WHITESIDES (CLITHEROE), LIMITED, Empire Buildings, Parson Lane, Clitheroe, Lancs.

COMPANY NEWS

(Figures for previous year in brackets.)

Tecalemit—Interim dividend of 6% (same).

Armstrong Stevens—Dividend of 17½% (same).

Josuah Bigwood & Son—Interim dividend of 5% (same).

Herbert Morris—Interim dividend of 5%, tax free (same).

John I. Thornycroft—Interim dividend of 5% (same).

Brooke Tool Manufacturing—Interim dividend of 7½% (same).

Cochran (Annan)—Interim dividend of 1½%, tax free (same).

Atlas Steel Foundry & Engineering—Interim dividend of 15% (same).

Tube Investments—Interim dividend on the ordinary stock of 10% (same).

Heenan, Beddow & Sturmey—Dividend of 15% for the year ended November 30, 1942 (nil).

Rawlplug Company—Final dividend of 30% on the ordinary shares, making 40% for 1942 (same).

Parkinson & Cowan—Profit for 1942, £48,423 (£45,395); dividend on the ordinary shares of 5% (same).

Skefko Ball Bearing—Final dividend of 6½d. per 5s. unit, or 10 5-6ths per cent., tax free, making 17½%, tax free (same).

Harrison (Birmingham)—Profit for 1942, after tax, £53,307 (£50,595); dividend on the ordinary shares of 20% (same), free of tax.

Tharsis Sulphur & Copper—Net loss for 1942, £26,937, after writing off £16,815 for depreciation; forward, £31,144 (£58,081).

Babcock & Wilcox—Profit for 1942, £623,443 (£616,021); final dividend on the ordinary stock of 6%, plus 1% cash bonus, making 11% for the year (same).

Yorkshire Engine—Trading profit for 1942, £6,972 (£6,169); reserved for tax, £4,000 (£6,000); two years' preference dividend, £1,500 (same); forward, £7,241 (£5,770).

Quirk, Barton—Profit for 1942, £9,368 (£9,483); taxation, £2,500 (£2,600); depreciation, £1,750 (same); final dividend of 6%, making 8½% (same); forward, £20,381 (£20,256).

Hopkinsons—Profit for the year to January 31, 1943, after taxation, depreciation, fees, etc., £62,598 (£55,215); final ordinary dividend of 12%, making 17½% (15%); forward, £92,982 (£73,260).

Projectile & Engineering—Net profit for 1942, £107,895 (£104,539); general reserve, £10,000; obsolescence reserve, £40,000; final dividend of 12½%, making 20% (same); forward, £31,530 (£33,635).

Kitchen & Wade—Bonus of 5% for the year ended March 31, 1942, making 30% for the year (same), and a second interim dividend of 12½% for the year ended March 31, 1943, making 25% for the year so far.

Anderson-Grice—Gross profit to September 30 last, £30,987 (£24,158); depreciation, £2,679 (£2,640); taxation, £22,203 (£16,100); war damage insurance, £748 (£856); ordinary dividend of 3s. (3s. 6d.) per share, £2,475 (£2,887); forward, after preference dividends, £1,311 (£551).

Robey & Company—Trading profit for 1942, £82,222 (£72,164); taxation and contingencies, £60,000 (£50,000); net profit, £13,673 (£13,024); dividend of 5% on the non-cumulative preference shares, £3,017; dividend of 5% (same) on the ordinary shares, £3,905; forward, £16,722 (£12,422).

Smith & McLean—Profit for 1942, after charging depreciation, taxation, contingencies, bad debts, war insurance and fees, £50,676 (£49,669); to reserve, £10,000 (same); supplementary depreciation and obsolescence, £20,000 (same); dividend of 11% (same) and a bonus of 4% (same); forward, £66,337 (£63,786).

Ransomes, Sims & Jefferies—Net profit for 1942, after providing for E.P.T. and income-tax and writing off A.R.P. expenditure, £44,985; preference dividend, £5,500; to reserve for post-war reconstruction and contingencies, £20,000 (£30,000); dividend on the ordinary stock at 7½% (same); forward, £55,359 (£54,624).

Settle Speakman—Trading profit for 1942, after providing for depreciation and bad or doubtful debts, £145,758 (£152,910); interest on debenture stock, £12,324; debenture stock redemption, £7,176; taxation, £96,000; net profit, £29,158 (£28,530); dividend of 10% on the ordinary stock, plus a bonus of 2½%, making 12½% (same); forward, £35,803 (£56,646).

Victaulic—Net profit for 1942, after reserve for E.P.T. and income-tax, £15,975 (£21,524); special depreciation, £5,000 (£10,000); final preference and ordinary dividend of 3%, less tax, with bonus of 9d. per share, free of tax, making for the year on both classes of shares 6%, less tax, with bonus of 1s. 6d. per share, free of tax (same); forward, £10,255 (£10,530).

Stewarts and Lloyds—Consolidated profit for the year 1942, including the company's proportion of the profits of subsidiary companies, £1,152,146 (£1,133,607), after providing for depreciation, war damage insurance premiums, E.P.T., N.D.C., and income-tax; reserve for special depreciation, £250,000 (£100,000); reserve for contingencies, £250,000 (same); dividends on the cumulative preference stocks, less tax, £121,202; dividend of 12½ per cent. (same) on the deferred stock, and at the appropriate rate on the 625 liaison deferred shares, less tax, £534,050; forward, £193,081 (£192,875).

Colvilles—Profit for 1942, after providing for taxation and war damage insurance, £513,323 (£523,759); net dividends from subsidiary companies, £199,212 (£79,437); depreciation and obsolescence of fixed assets, £300,000 (£350,000); deferred repairs, £100,000 (nil); dividend on the 5½% cumulative preference stock, £55,000; ordinary dividend of 8% (same); forward, £166,963. Repayment of a further £100,000 was made against the insurance loan, reducing it to £800,000. The Steel Company of Scotland, Limited, incurred a loss. The other subsidiary companies made profits, but the profit of Archibald Russell, Limited, did not permit the payment of a dividend.

STANTON *Dale* REFINED PIG IRON

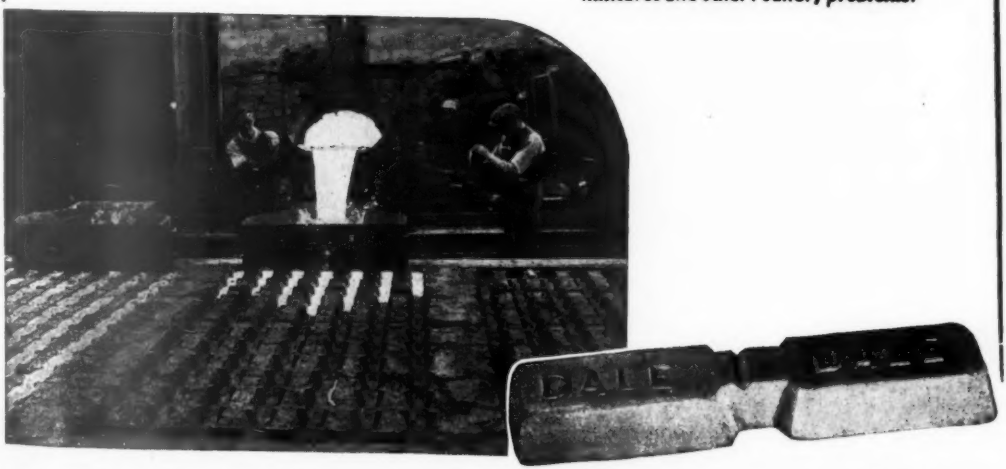
IS CHARACTERISED by closeness of grain structure, uniformity of composition and fine graphitic carbon evenly distributed.

IS PRODUCED to guaranteed analysis in seven standard grades.

CAN BE MADE to customers' individual requirements with total carbon from 2·6 per cent. upwards.

SHOULD BE USED to tone up high phosphorus irons and scrap, to replace Hematite, and to produce castings for all high duty purposes.

Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

Raw Material Markets

IRON AND STEEL

The position of the light-foundry trade seems to be improving steadily; more and more units in this industry are taking up the production of castings for various Government departments, although there is still room for considerable expansion in this direction. Until recently light foundries were being closed down under the concentration of industry scheme, but the authorities have deemed it advisable to call a halt in their original plans. A number of light foundries are now producing engineering castings, with the result that they are taking up supplies of the better grade irons. Normally, their requirements are satisfied with iron of high-phosphorus content.

Engineering and allied foundries are very actively employed on work of vital importance to the war effort, and most of them have their order-books filled over a considerable period ahead. These foundries use low- and medium-phosphorus iron and hematite, which are now in short supply, but they are utilising also other grades, including high-phosphorus iron, which are more easily obtained, being produced from ores found in this country. Steel scrap is also playing its part in meeting the requirements of makers of heavy castings. On the whole, their raw material needs are being covered satisfactorily, but larger tonnages of the better grade irons would undoubtedly be appreciated.

Adequate supplies of coke continue to reach the foundries. Many consumers rely on regular weekly deliveries, and they are not disappointed, as transport arrangements are operating satisfactorily. Users who have accommodation for stocking coke mostly have large quantities in hand, and they are intent on filling their stacking ground before the end of the summer, so that prospects for next winter should be as favourable as possible.

Steel plates continue to be absorbed at a fast rate, and at many of the mills deliveries have fallen behind schedule. Special attention is being paid to the needs of the shipbuilders, whose requirements have never been at a higher level. Large tonnages of steel plates are also called for by other heavy industries, so that the output is earmarked over a long time forward. Demand for special qualities of steel is maintained at an unprecedented level, as these descriptions are playing a vital part in the manufacture of armaments, munitions, etc. Producers are fully engaged, and every opportunity is taken of increasing outputs, although this is difficult now, as developments in this sphere in recent months have been very considerable. Full-time operations are reported in the sheet trade; demand has lately fallen away to some extent, but it is expected that it will return to recent levels in the near future, as sheets are utilised extensively in the production of war materials. Other sections of the steel industry continue to be busy.

NON-FERROUS METALS

The cessation of fighting in North Africa may result in the reopening of the Mediterranean to Allied shipping. If this can be achieved, the shipment of zinc concentrates and zinc metal from Australia and Tasmania would be materially assisted by the shortening of the sea route. Lead, too, would be more freely available, as, in the past, it has been the hazards of the seas which have tightened the reins on supplies.

Spelter continues to be in brisk demand and this is particularly so in the case of high-grade metal, which is used for the manufacture of zinc alloy, die castings, etc. Priority consumers are not going short, but the authorities are exercising rigid control over distribution and there is little to be had by users not included on priority lists. There is little change in the position of copper and tin, supplies of which are still being allocated with the utmost care.

NEW COMPANIES

(*"Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.*)

Alan Best (Engineering), 235, Queenstown Road, Battersea, London, S.W.8—£1,000. A. Best and A. A. Chenery.

Letchworth Heat Treatment & Hardening Company—£3,000. S. T. Anderson, 111, Norton Way South, Letchworth, Herts.

T. Masters & Sons (Park Foundry) Company, 74, Glover Street, West Bromwich—£1,000. T., T. J., and G. Masters, and E. E. Tilley.

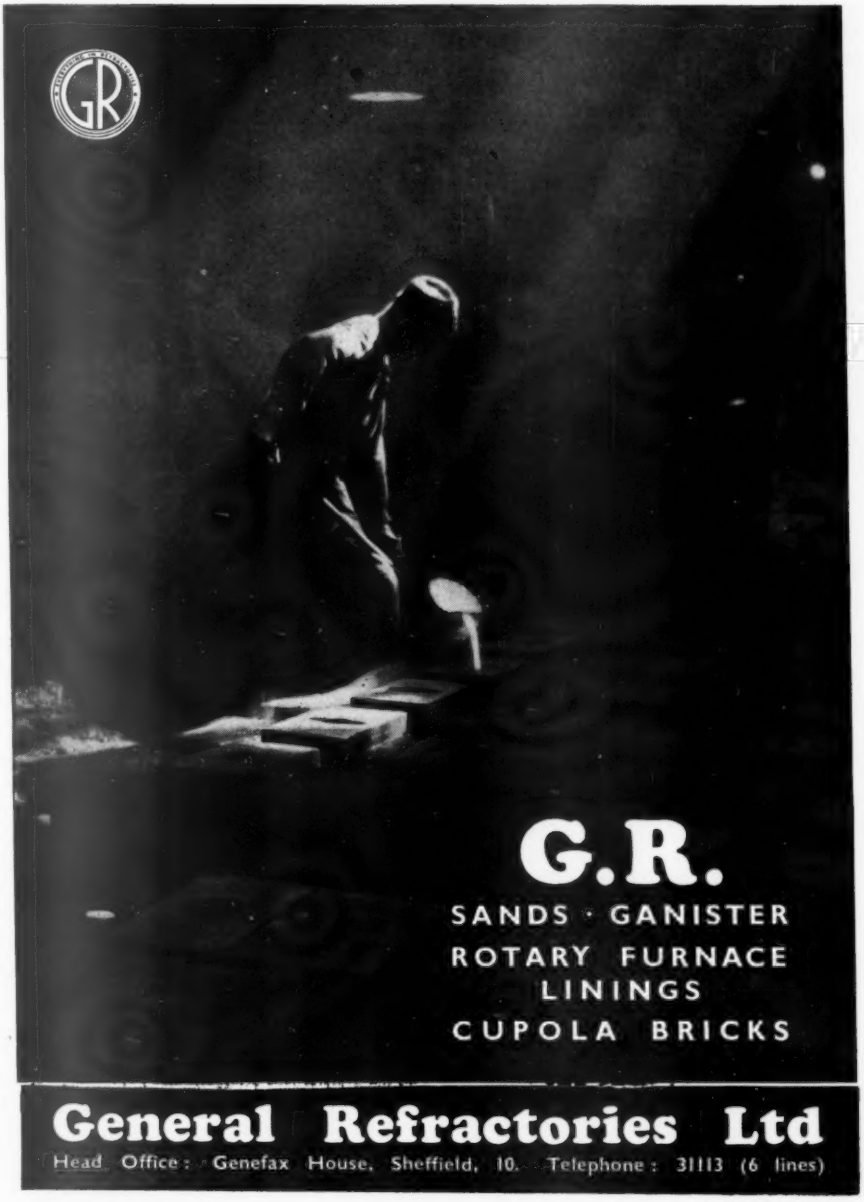
Newton Bros. (Birmingham), 232, Slade Road, Erdington, Birmingham—Engineers and tool makers. £1,000. P., A. W. J. S., and A. Newton.

Weldwell, 54A, Oldbury Road, West Smethwick, Birmingham—£1,000. Welders, etc. D. H. Atack, W. T. Hadley, R. B. Millar, and G. W. Ridout.

High Grade Metal Tests—Suppliers of fluorescent lighting for detecting flaws in metals, etc. £1,000. S. W. Wilkins, Chesham House, Broxbourne, Herts, subscriber.

K. J. & A. Sommerfeld—To take over the business of engineers carried on by K. J. and A. Sommerfeld at Cowley, Uxbridge, and at Trench Works, Hadley, and elsewhere. £5,000.

MR. W. M. HYMAN, chairman of the West Riding Education Committee, opened recently the first section of a works college, designed to provide training for young entrants to the firm of Newton, Chambers & Company, Limited. The company have for some time had a special course of instruction for boys wishing to enter their collieries. Now, they are developing a more comprehensive plan with the object of ensuring that all young people wishing to enter any section of their industrial organisation shall be provided with part-time training during normal working hours. The new college building just opened has been designed primarily for the training of administrative workers.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GP 171

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, May 19, 1943

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.)

Hematite.—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 220s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

(Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.)

Ferro-silicon (5-ton lots): 25 per cent., £21 5s.; 45 per cent., £23 10s.; 75 per cent., £36 10s.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/6 per cent. C, £44; max. 2 per cent. C, 1s. 0½d. lb.; max. 1 per cent. C, 1s. 1½d. lb.; max. 0.5 per cent. C, 1s. 1¾d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 5d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.41 to 0.60 per cent. C, £14 10s.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£12 2s. 6d., 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅜ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d., f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 10s.

Tin.—99 to under 99.75 per cent., £275; 99.75 to under 99.9 per cent., £276 10s.; min. 99.9 per cent., £278 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11¾d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10¾d.; wire, 10¾d.; rolled metal, 10¼d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

Phosphor Bronze.—Strip, 13¾d. per lb., sheets to 10 w.g., 14¾d.; wire, 16d.; rods, 16d.; tubes, 21¼d.; castings, 19d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 15 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5¼d. to 1s. 11¼d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6¼d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9¼d. Wire round, to 10g., 1s. 7¼d. to 2s. 2¼d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6¼d. upwards.

NON-FERROUS SCRAP

Controlled Maximum Prices.—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s.; braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ½ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £74 10s., all per ton, ex works.

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended May 15, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

BRASS.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

CUPRO NICKEL.—80/20 cupro-nickel webbing, £75 10s.; 80/20 defective cups and envelopes before filling, £70 10s.

NICKEL SILVER.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

COPPER.—Sheet cuttings and webbing, untinned, £54; hell-band plate scrap, £56 10s.; copper turnings, £48.

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3¾ per cent. dealers' remuneration. 50 tons and upwards over three months, 2s. 6d. extra.*)

South Wales.—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

Middlesbrough.—Short heavy steel, 79s. 9d. to 82s. 3d.; heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

Birmingham District.—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.; ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

Scotland.—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(NOTE.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less.*

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SITUATIONS VACANT AND WANTED

FOUNDRY MANAGER seeks situation; 40 years' experience in producing iron castings up to 15 tons, including bedplates, without patterns.—Box 834, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY METALLURGIST required to take control of Melting Department of a large Iron Foundry in Scotland. —Apply in writing, stating age, experience, and salary required, to No. 363, THE MINISTRY OF LABOUR AND NATIONAL SERVICE, Appointments Office, 145, St. Vincent Street, Glasgow, C.2.

SUPERINTENDENT or HEAD FOREMAN required, of wide general experience, to take charge of Brass Foundry section in Non-Ferrous Metal Refining Work in Birmingham area; non-ferrous experience desirable, but not necessarily essential; remunerative, progressive, and permanent position for the right man.—Apply, stating wages required, to Box 824, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MELTING HEAD FOREMAN required by a Modern Laboratory controlled Bronze Foundry; experience with oil-fired tilting furnaces essential; progressive and permanent position for capable applicant.—Write, stating age, experience, and salary required, to Box R.717, WILLING'S, 362, Grays Inn Road, London, W.C.1.

HEAD FOREMAN MOULDER required; must be capable of running this section of a large steel foundry producing castings up to 5 tons; state age, education and experience.—Box 848, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

BUSINESS WANTED

MIDLANDS AREA. — Substantial Engineers; interested in the outright purchase of Iron or Steel Foundry. Give full details.—Box 810, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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INGERSOLL-RAND SIZE 6, TYPE X.V.O., DIESEL-DRIVEN, TWO-STAGE, AIR COMPRESSOR, having h.p. cylinder 9½ in. dia. and two l.p. cylinders, both 13 in. dia.—all 12 in. stroke.

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MACHINERY—*contd.*

WANTED.—Bandsaw Machine, for cutting aluminium castings.—State price and particulars to GEORGE REIGHLEY, LTD., Bankhouse Ironworks, Burnley.

WANTED.—MANHOLE INSPECTION COVER AND FRAME; pattern size; 30 in. by 30 in. opening; approx. weight 4 cwts. Also one CORE SAND MIXER; 1-cwt. size; pulley driven (secondhand).—Particulars to MATTHEW LONGSON, Market Place Foundry, Chapel-en-le-Frith, via Stockport.

WANTED.—One Plain Jolting Machine, to take 14-in. by 16-in. moulding box.—Reply to Box 840, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

WANTED.—One Compressed Air Jolt Squeeze Straight Draw MOULDING MACHINE and One Jolt Squeeze Rollover Moulding Machine. Both machines to take boxes approximately 20 in. by 18 in. Must be modern type and in good condition.—Apply, stating price and where machines can be seen, to Box 842, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

WOULD EXCHANGE Ajax No. 6 MOULDING MACHINE, pattern draw 13 in., two years old, very little used, for British Moulding Machine; "turn-over" type; No. A.T.3 or A.T.4; 9 in. pattern draw.—Box 844, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOR SALE.—Sand Slinger; complete with elevator, storage boot and self-propelling unit; electric driven.—Box 846, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

KOMINOR Continuous Grinding Ball Mill; drum 5 ft. 5 in. inside dia. by 4 ft. 3 in. long; can be inspected North London by appointment.—Box 850, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUR Hydraulic (750 lbs. per sq. in.) squeeze type Turnover Moulding Machines, by the Foundry Equipment, Ltd.; their pattern, T.2; these accommodate a moulding box inside, dimensions 17 in. by 21½ in.; centre pins 25 in.—Box 826, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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FOR SALE.—HAND RAM rollover and pattern draw MOULDING MACHINE, with table 30 in. by 18 in.; as new; £25.—Box 838, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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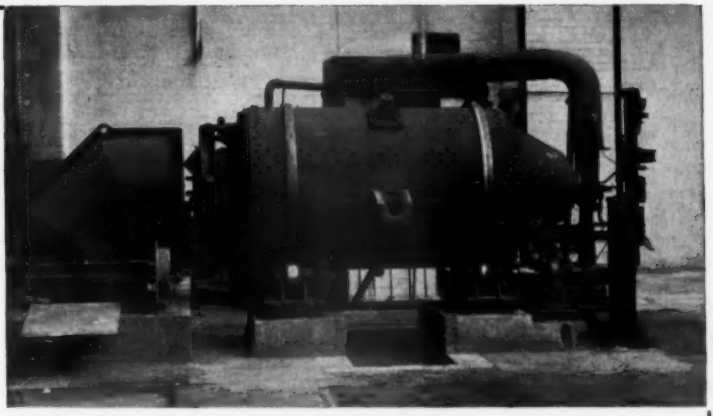

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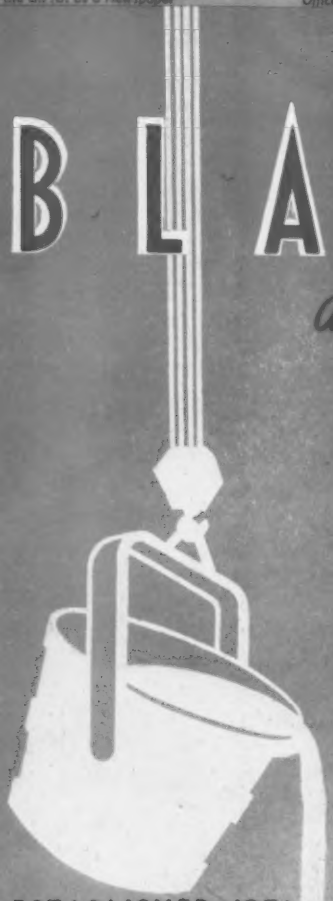

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